

ABSTRACT

The present invention provides actuators and actuator devices that take advantage of a strain gradient variation of an actuator element between a first phase and a second phase. The actuator elements can be positioned in any type of shape. For instance, the actuator element in the first phase can be any type of curved, non-linear or irregular shape as long as a strain gradient along a cross-section of the actuator element can be established. The actuator element in the second phase is positioned in a different shape when compared to the first phase as long as it is in a direction to minimize the strain gradient. Different actions can be generated such as a rotary movement, a linear movement, an expanding movement, or a combined linear and rotary movement. The actuator element could also be configured to generate a linear movement by combining contraction and strain gradient variation.